

# The Jupiter Laser Facility - Capabilities



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# Jupiter is a multi-platform facility for high energy-density (HED) science



## Mission

- Expand the frontiers of high energy-density laboratory science
- Support high energy-density science at LLNL in multiple programs
- Support, collaborate with, and expand the broader HED physics community
- Help train and recruit future scientific workforce

## Approach

- SC-style user facility at which laser time is provided free-of charge and apportioned through an open, competitive peer-review process
- On a flexible intermediate scale
- With a variety of platforms capable of front-rank HED science for different classes of experiments
- And the infrastructure to safely support multiple users with a range of experience levels

# **Jupiter is a multi-platform facility for high energy-density (HED) science**

## **Approach**

- **Office-of-Science-style user facility where all laser time is provided free-of-charge and apportioned through an open, competitive peer-review process**
- **On a scale that provides significantly more laboratory access and greater flexibility than large-scale laser facilities**
- **With a variety of platforms capable of front-rank HED science for different classes of experiments**
- **And the infrastructure to safely support multiple users with a range of experience levels**



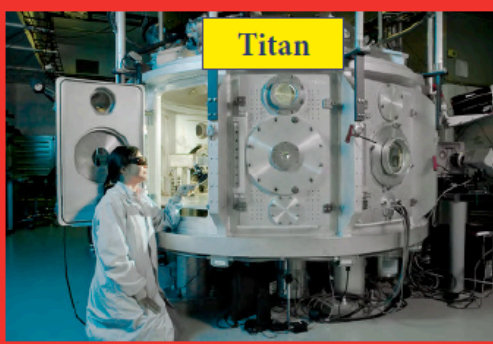
# Jupiter Laser Facility



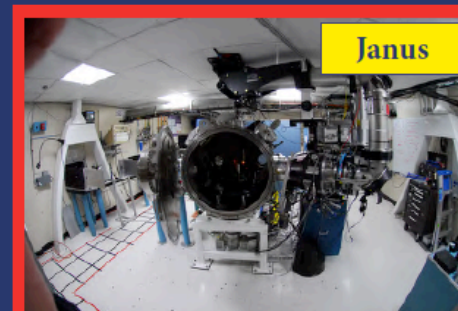
Callisto



Titan



Janus



COMET



Laser Bay



Europa



Setup Room



Target Fab



Expanding High Energy-Density Science



# Jupiter Laser Facility

## Janus Laser

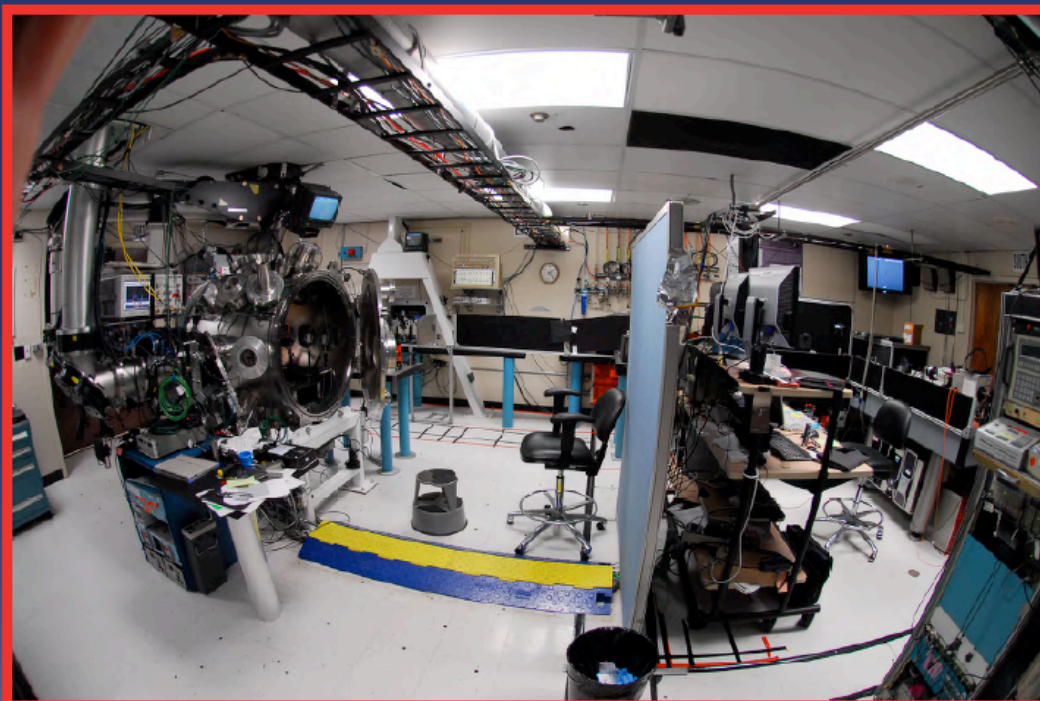


Two independent long-pulse (ns) 1-kJ beams

Both East and West beams have  
the following capabilities

$\lambda$	1053 nm	527 nm
Pulse	0.35-20 ns	0.35-20 ns
Energy	Up to 1 kJ	Up to 500 J
Best Focus/ Phase Plates	20 $\mu\text{m}$ / 200-1000 $\mu\text{m}$	20 $\mu\text{m}$ / 200-1000 $\mu\text{m}$
Rep Rate	2/hr	2/hr

- Short-pulse 50-mJ probe available
- Beam synch continuously variable; 50 ps jitter
- VISAR and SOP are permanent diagnostics



Target chamber accepts multiple beam positions





# Jupiter Laser Facility

## Titan Laser



Combined long-pulse 1-kJ and short-pulse PW-class beams



	Long-Pulse Beam		Short-Pulse Beam	
$\lambda$	1053 nm	527 nm	1053 nm	527 nm
Pulse	0.35-20 ns	0.35-20 ns	0.7-200 ps	0.7-200 ps
Energy	Up to 1 kJ	Up to 500 J	Up to 300 J	Up to 50 J
Best Focus/ Phase Plates	20 $\mu\text{m}$ / 200-1000 $\mu\text{m}$	20 $\mu\text{m}$ / 200-1000 $\mu\text{m}$	8 $\mu\text{m}$	8 $\mu\text{m}$
Rep Rate	2/hr	2/hr	2/hr	2/hr



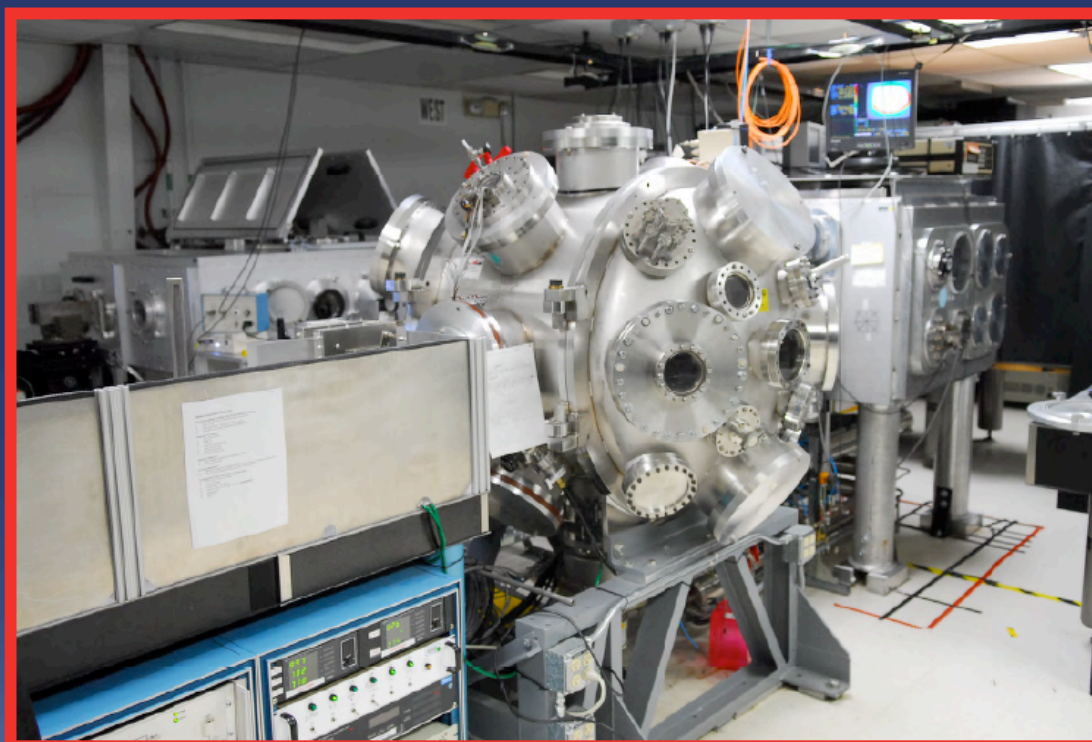
# Jupiter Laser Facility

## Callisto Laser



Sub-100-fs laser capable of 200 TW in single-shot mode

Capabilities		
Mode	High Rep	Single-Shot
$\lambda$	800 nm	800 nm
Pulse	60 fs	60 fs
Energy	120 mJ	12 J
Best Focus	5 $\mu\text{m}$	5 $\mu\text{m}$
Rep Rate	10 Hz	2/hr
– 5-mJ, 60-fs probe available		



Two available target chambers



# Jupiter Laser Facility

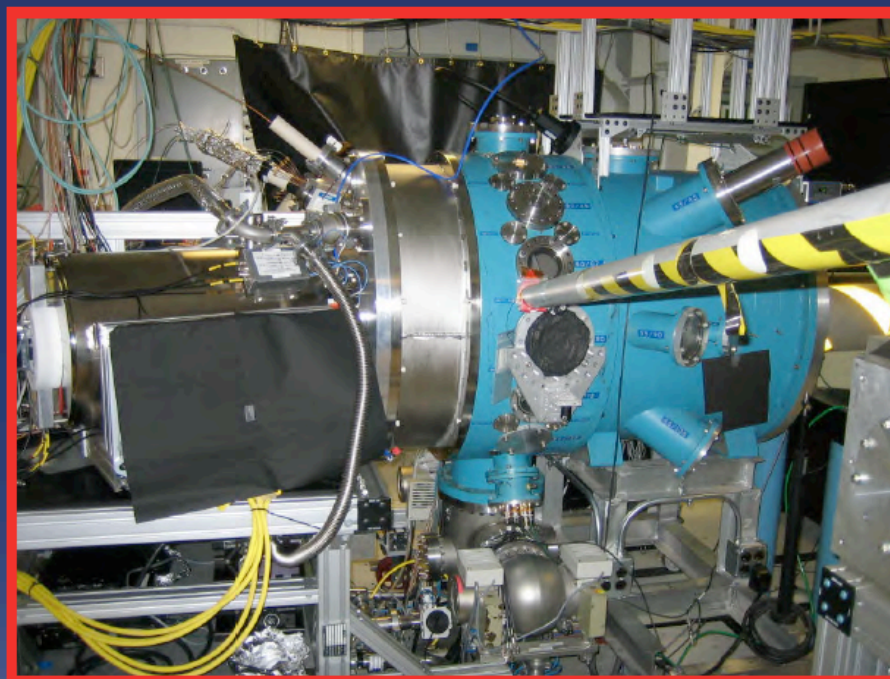
## COMET Laser



### COmpact MultipulsE Terawatt - a versatile multibeam system

#### Capabilities

Beam #	1	2	5
$\lambda$	1053/527 nm	1053/527 nm	1053/527 nm
Pulse	0.5-260 ps	750 ps	0.5-6 ns
Energy	15/8 J	10/20 J	20/10 J
Best Focus	$7 \times 10 \mu\text{m}$	$2 \times \text{Diff Limit}$	$2 \times \text{Diff Limit}$
Rep Rate	15/hr	15/hr	15/hr
<ul style="list-style-type: none"><li>- Two additional long-pulse/short-pulse lines (Beams 3 and 4) available</li><li>- Beams 1-4 can be operated simultaneously</li></ul>			



COMET can operate several beams concurrently  
with a 4-minute cycle time between shots





# Jupiter Laser Facility

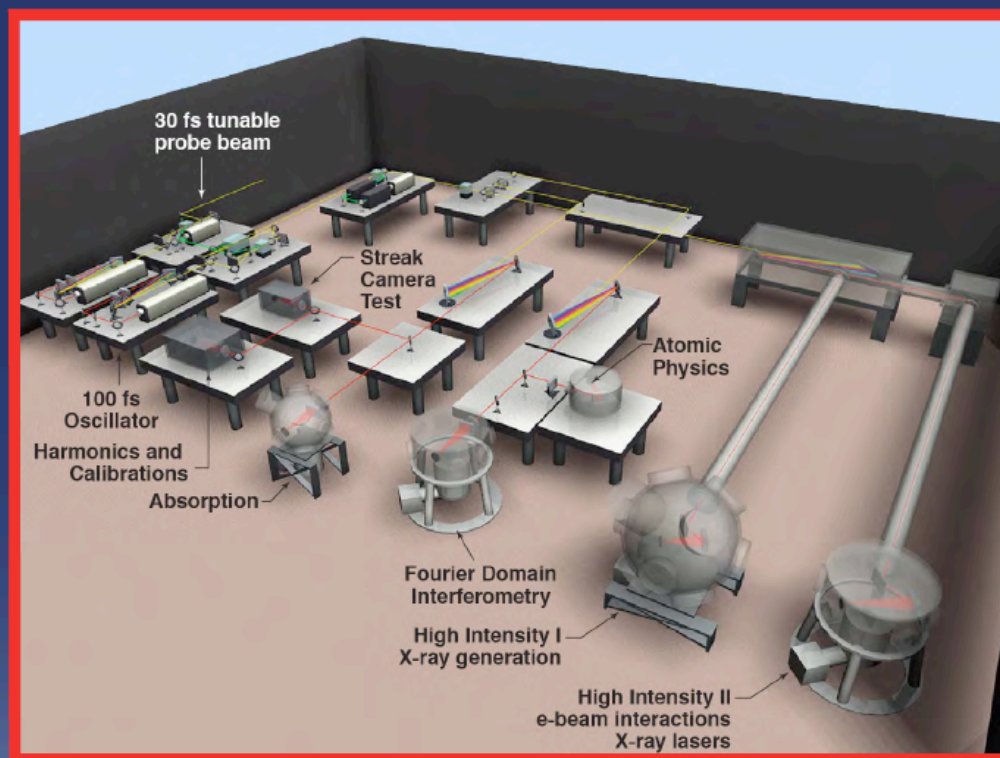
## Europa Laser



### 20-mJ 120-fs, 10-Hz Ti:Sapphire system

#### Capabilities

$\lambda$	800 nm	400 nm
Pulse	120 fs	100 fs
Energy	20 mJ	6 mJ
Best Focus	3× Diff Limit	3× Diff Limit
Rep Rate	10 Hz	10 Hz
<ul style="list-style-type: none"> <li>– Pulses can be multiplexed</li> <li>– Multiple target chambers</li> </ul>		



Europa is a well-equipped system especially suitable for configuration tests and training

# Jupiter is a multi-platform facility for high energy-density (HED) science

Goal	Metric	
Broad participation by LLNL researchers	Growth in LLNL user base	Users up 200% in 4 years
Expanded HED community	Growth in non-LLNL user base and expanding diversity of user institutions	<ul style="list-style-type: none"> <li>- Users up 300% in 4 years</li> <li>- 56 universities</li> <li>- 20 institutes</li> </ul>
Front-rank HED science	Publications	<ul style="list-style-type: none"> <li>- ~24 journal publications/year</li> <li>- ~4 PRL/Science pubs/year</li> </ul>
Staging of expts to larger facilities	Evidence of those expts at NIF, $\Omega$ , <i>etc.</i>	XRTS, $e^+$ beams, ramp and Hugoniot EOS, FI, NLTE
Development of novel HED diagnostics	Implementation of diagnostics at NIF, $\Omega$ , <i>etc.</i>	2D VISAR, p+ radiography, fast detectors, x-ray sources
Training of young researchers	Growth in number of students, number of PhDs using JLF, and awards associated with JLF	<ul style="list-style-type: none"> <li>- 117 student users</li> <li>- 2 young researcher awards</li> <li>- 8 PhDs per year</li> </ul>
Pipeline into LLNL	Number of students hired by LLNL	Since 2009, 14 of 32 PhDs hired at LLNL